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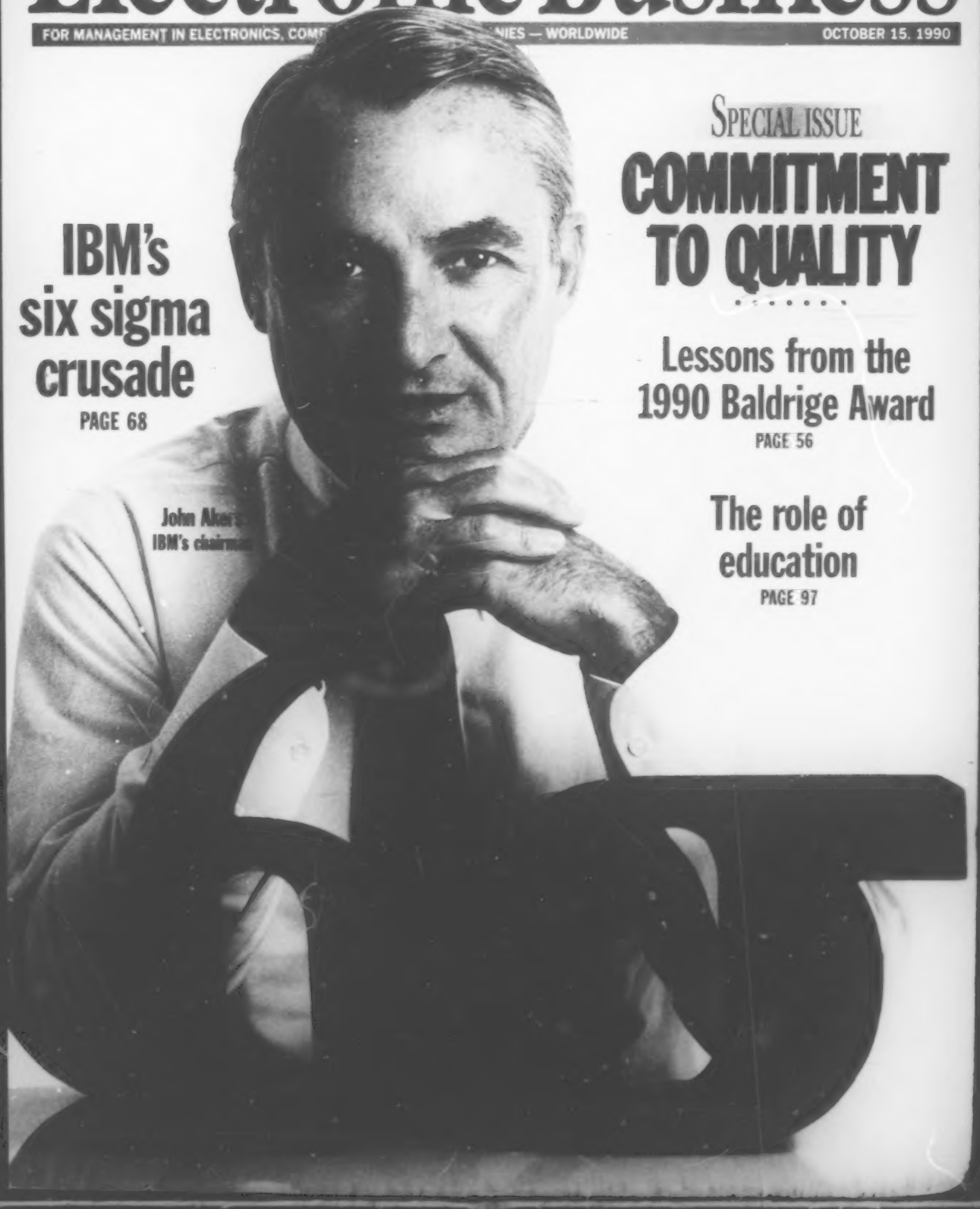
Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMP... ...NIES — WORLDWIDE
OCTOBER 15, 1990



SPECIAL ISSUE

COMMITMENT TO QUALITY

IBM's six sigma crusade

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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES—WORLDWIDE

VOL. 16, NO. 19 OCTOBER 15, 1990

COMMITMENT TO QUALITY

Cover: Jonathan Levine

PAGE 68 Chairman John Akers is pushing IBM to reach six-sigma quality by 1994

COVER STORY/IBM

68 Market-Driven Quality: six sigma crusade

For the second year, ELECTRONIC BUSINESS devotes an issue to the electronics industry's drive for quality in manufacturing and service. This year's coverage starts at the top of the industry with IBM Corp. — a giant company with giant manufacturing and market-share headaches. Chairman John Akers's prescription is Market-Driven Quality, strong medicine that will affect every IBM customer, employee and supplier worldwide. IBM is borrowing heavily from the six-sigma approach to total quality control used by Motorola Inc., winner of a Malcolm Baldrige National Quality Award.

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Exclusive CEO survey of industry's quality; university teaches reading, writing and quality; telecast explains Baldrige process; industry seeks common quality language; Taiwan PC buyers focus on service; Baldrige examiners needed; quality process saves military millions; new distributor standard nears; poor quality proves costly; Compaq aims for one-day manufacturing.

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The model for IBM's companywide quality push is the midrange computer facility in Rochester, Minn. The plant is upgrading nearly every one of its operations, and its philosophy could be summed up as: "If it's not perfect, make it better."

COMMITMENT TO QUALITY

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Quality crusade needs six-sigma reporting

Why devote an entire issue of ELECTRONIC BUSINESS to the subject of quality? Because quality has become the key to competitiveness, and the competitiveness of the U.S. electronics industry is an overriding concern for us, as it is for you, our readers.

Indeed, knowing how seriously our readers take such principles as total quality and "zero defects," we knew that our Commitment to Quality issue would have to mirror the quality efforts of the companies we cover. We took a lesson from the consultants and CEOs we interviewed — namely that communication and teamwork are all-important to total quality. If the Malcolm Baldrige National Quality Award were to be granted on the basis of teamwork alone, we would be a strong contender. The past several weeks have seen a massive team effort by our staff and freelance editors to produce nearly twice our average number of feature articles.

Our roster includes an impressive group of industry savants, among them: Curt W. Reimann, national director of the Baldrige Award program; world-famous quality-control expert Armand V. Feigenbaum, and leading high-tech management consultant Michael E. McGrath.

But we didn't stop there in assembling a world-class quality team. Among our most valuable players were U.S. electronics CEOs we surveyed for this issue. We asked these executives to tell us about their reasons for stressing quality, the tools they used to insure it, the quality training they gave their employees and, most important, the bottom-line benefits of quality in terms of production costs and market share. These CEOs' candid responses provide a benchmark for our readers and for ourselves.

Bruce Rayner, managing editor: aiming for six-sigma editorial quality

We needed every bit of that expert teamwork. The quest for quality by leading companies has become a national corporate crusade. The grail of that crusade, the Baldrige Award, drew 97 applicants this year, compared with 40 in 1989 and 66 in 1988. Our editors even found a host of companies applying *after* the application deadline just to learn how they stack up.

And when IBM's John Akers, the company's chief crusader and the man on our cover, borrows Baldrige winner Motorola Inc.'s six-sigma defect-reduction strategy, can there be any question that the national commitment to quality is real?

JOHN W. PARKER, section editor

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BPA ABP

How does your quality rate?

Use our exclusive survey results of corporate performance as a benchmark for your company's improvement program

In a recent survey conducted by ELECTRONIC BUSINESS, we asked electronics-industry CEOs to tell us something about their in-house quality programs. The results are a gauge by which to measure where your company stands in its quest for quality.

According to the results, most electronics companies have at least set out on the quality journey. Three-quarters of the companies polled have a quality program and a corporate-level quality executive. However, only half of the companies have published an official corporate "quality statement."

What is motivating these companies to improve quality? The majority say their customers are demanding higher quality standards. To date, 9% admit to having lost business because of poor quality. These companies are also demanding that their suppliers adopt quality standards. Somewhat surprisingly, more than 50% admit to being satisfied with their suppliers' quality efforts.

Most quality training is still in the factory. Line managers and factory employees receive the most training, while office employees get the least. Quality-training budgets are rising very slowly. Last year, companies surveyed spent an average of $122,000 on quality training and education and this year they expect to spend $127,000.

What are the most popular quality tools used by U.S. electronics companies? Statistical process control is the most common and is used by 50% of the companies surveyed. A full 60% still rely on final product inspection as a quality control which is anathema to modern quality theory.

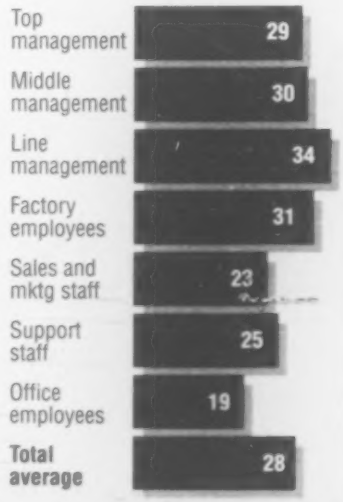
All companies polled report some improvements in operations as a result of their quality initiatives. Most dramatically, these companies claim to have reduced product cost an average of 21% since starting their quality programs and have increased market share by 25%. How does your company measure up?

BRUCE RAYNER WITH XIONG XIAOGE

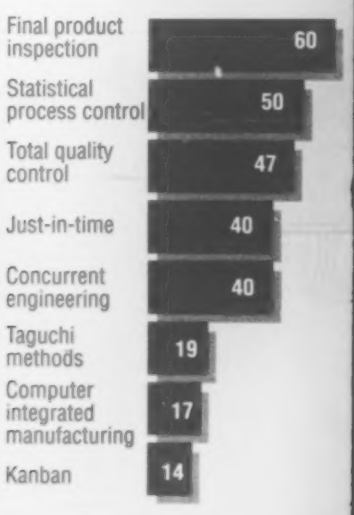
Q: Estimate how much your company spent/will spend on quality training and education.
($ in thousands)

Sales	For in-house employees 1989	For in-house employees 1990	For suppliers 1989	For suppliers 1990
over $1B	500	1,000	100	200
$100M to $1B	413	269	132	138
$10M to $100M	92	105	47	24
$1M to $10M	24	59	7	22
Average	**122**	**127**	**53**	**48**

Q: How many hours of education and training in quality concepts do the following categories of employees receive a year?
(percentage of total responses, average hours)



Q: Which quality techniques/programs does your company practice?
(percentage of total responses answering in the affirmative)



This survey was conducted in June, 1990. Questionnaires were mailed to 1,000 CEOs of U.S. electronics companies, both public and private, with a response rate of about 6%. For further details, contact Bruce Rayner: (617) 558-4736.

Q. If your company has employed outside consultants, have the results been...
(percentage of total responses)

Q. Since starting your quality program, what results has your company achieved?
(average percent change of total responses)

Product cycle time reduced by	37%
Work-in-process inventory reduced by	36%
Per-unit cost reduced by	21%
Cost of rework reduced by	39%
Total employment reduced by	17%
Defects per 1,000 reduced by	28%
Customer rejects reduced by	32%
Market share increase by	25%
Final inspection reduced by	39%
Number of suppliers reduced by	32%
Employee productivity improved by	30%

EDUCATION

Today's lessons: reading, writing, quality

MANY SILICON VALLEY technology companies are going back to school in order to prepare for the Malcolm Baldrige National Quality Award competition. Local companies, both large and small, are looking to San Jose State University's Center for Productivity and Manufacturing Engineering as a unique resource for objective quality education and training in quality methods.

Jay Pinson, the university's Dean of Engineering, established the center back in 1983 and expanded the school of engineering facilities with a $45 million investment, including $15 million from industry. Since 1988, the center has been training local electronics executives and professionals in all aspects of quality.

Courses include everything from one-day top management sessions to three-day courses on performance measures, design of experiments, statistical process control and total quality management. "Applications are our niche," says Bob McQueen, the center's director.

Corporate support is strong, claims McQueen. So far, the class roster has included the likes of General Electric Corp., Unisys Corp., Sun Microsystems Inc., Apple Computer Corp. and Intel Corp. Individuals instrumental in developing the program include Bob Puette, president of Apple USA, and Rick Willson, an Intel quality improvement professional.

While corporate support is needed, it is the smaller high-tech suppliers that face the most difficult challenges, says McQueen. They are "the Achilles heel" in the efforts to raise the general level of quality in American manufacturing. Smaller companies often lack resources such as training departments and are under increasing pressure from companies such as Motorola Inc. that require they apply for the Baldrige Award.

Helping companies learn from the Baldrige Award process is a special focus at the center. "Sometimes, companies are in a situation where they can answer all the application questions but can't build results in their organization. Our model shows which systems within the organization are linked to the Baldrige requirements," says McQueen.

The model breaks down six corporate areas — strategic planning, operational controls, technical systems, human resources, education and training and continuous improvement functions — so students can identify where they need to strengthen their internal controls. But that's only the start of the training. "Once you identify where you need to improve, you then need knowledge. We are knowledge providers," says McQueen.

For more information on courses, contact the center at (408) 924-4144.

TERI SPRACKLAND

BALDRIGE AWARD

Telecast to explain Baldrige process

WANT TO KNOW more about setting up a total quality program and entering the competition for a Malcolm Baldrige National Quality Award? On Jan. 22, 1991, an interactive telecast via satellite from the studios at George Washington University in Washington, D.C., will offer a chance to learn from the experts.

A morning session will feature a talk by Curt W. Reimann, director of the Baldrige competition and associate director of quality programs at the National Institute of Standards and Technology, Gaithersburg, Md. Guest speakers from former Baldrige Award-winning companies will include: Kenneth Leach, vice-president and chief quality officer for Globe Metallurgical; Robert Osterhoff, national quality manager for Xerox Corp., and William Smith, vice-president and senior quality assurance manager for Motorola Inc.. This will be followed in the afternoon by a panel discussion focusing on total-quality programs as well as the entry process. The moderator will be Baldrige examiner Jack B. ReVelle, chief statistician and a senior member of the corporate product operations staff at Hughes Aircraft Co. Then questions called or faxed in from around the country will be handled in a question-and-answer session.

The fee for broadcast via satellite dish to industrial companies is

COMMITMENT TO QUALITY

When producing the right stuff just isn't enough

Swiss equipment supplier ESEC has learned the hard way that customers demand first-rate service as well as first-rate products

BY BARBARA N. BERKMAN

Long before Japan became an industrialized power, it was the Swiss who were world-famous for precision and design. That national obsession with quality has been woven into a corporate philosophy at ESEC S.A., a manufacturer of semiconductor-assembly equipment based in Cham, Switzerland.

Since its founding in 1968, ESEC has emphasized product design as the key to reliability and quality. As a result, the company enjoys a reputation for producing machines that can compete with the best that Japan has to offer, as well as a 23% share of the global die-bonding market last year.

Given today's brutal market competition, however, ESEC has learned that even top-tier product quality is not enough. While ESEC pours money into quality design of die and wire bonders for the back end of semiconductor production, chip makers are contracting out the back-end assembly process and devoting more and more of their capital to the front end.

To keep its place in the market, ESEC is striving to improve customer support and service, historically an obstacle for smaller companies because of their limited resources. Looking back, says Jan Lipton, ESEC's corporate vice president of marketing, "Customer support was probably our weak point. Our product quality was so high, and our customers such experts on the machines, that we didn't need to pay too much attention to it."

ESEC is becoming more marketing-driven through extensive customer-education and by closing the gap between the buyer and the company's technical staff. "We need much more of that," says Lipton. "It's up to us to educate our customers."

Jan Lipton, ESEC's corporate vice president of marketing: Trying to educate customers with improved technical support

This year, ESEC reorganized and decentralized its sales and support functions. Previously, customer-support was provided by the headquarters staff, sales and technical managers from the sales outposts. But ESEC brought its technical managers closer to the customer by naming them the company's sole customer contacts. The company is also beefing up technical training for its support engineers who must now pass an annual examination on finding bugs in the machines. In addition, ESEC plans to train its customers rigorously on the machines, emphasizing ongoing education rather than merely point-of-sale training.

Design versus cost

ESEC's quality program is based on making sizable investments — typically 20% of sales — in product development. The company's attention to design has paid off: During the first six months of 1990, ESEC — which reported $22 million in sales for all of 1989 — booked more than $16 million in orders. Europe accounted for 57% of sales, the Far East 28% and the United States 15%.

The equipment maker's strategy may lead to more reliable machines, but it also adds many costs. Last year, for example, ESEC dropped a low-cost transport system for the lead frames from its wire bonders because repairs to the system meant an increase in downtime. ESEC spent $150,000 to develop an

alternate system.

In fact, product development on the machines never ends. ESEC uses data collected from the field to track whether design is the root of any problems; if so, the design is changed. "We work continually on our machines," says Lipton. "If we can't buy a part [to improve equipment performance], we develop the solution ourselves."

Attention to design can be as specific as the size of the openings in the series of nozzles that squeeze the epoxy used to connect the semiconductors to lead frames. ESEC designed the openings to be computer-controlled so that the size is optimal for each application. The method enhances quality significantly by minimizing excess adhesive. One appreciative customer even asked to purchase the redesigned nozzles separately. "You can buy our nozzles, of course, but there is a die bonder hanging from them," quips Lipton.

In a further move to design for quality, ESEC spent two years developing an air-bearing system for the Wirebonder 3006, a product introduced in 1989. The air-filled suspension system replaces a mechanical system, called a conventional spindle-driven X-Y system, and is five times more precise, ESEC claims.

In addition, the company spent $230,000 designing a five-phase motor drive to continuously transport the magazine of chips up and down the new wire bonders. The drive cost $385. Its predecessor, a fast DC drive, burned out after several hundred hours. While the old drive could have been replaced for about $54, ESEC reasoned that the time spent repeatedly replacing the old drive would seriously increase the machine's downtime.

The company is up against some powerful rivals in wire bonders in Japan and the United States: Shinkawa Ltd. of Tokyo, and Kulicke & Soffa Industries Inc. of Willow Grove, Pa. Shinkawa, better known than ESEC outside Europe, produces machines at a relatively low cost by using as many standard parts as possible. K&S, the world's second-largest wire-bonder maker with sales of $42 million in 1989, presents tough competition for ESEC's new wire bonders in the United States. ESEC is ranked eleventh in wire-bonding sales worldwide.

It's still too soon to judge the success of ESEC's new wire bonder. "It's a very good system and has what it takes to make it in the market," observes Jeff Burke, research manager of VLSI Research Inc. in San Jose, Calif., "but it isn't quantum steps beyond Shinkawa or Kulicke & Soffa."

Still, ESEC seems to have an unshakeable reputation for overall quality among its customers: ESEC ranked second — after ASECO, a supplier of IC handlers — in overall performance in a semiconductor-equipment-buyer survey conducted last year by VLSI Research. ESEC's products scored an uptime rating of 8.9 when customers were asked to rate uptime on a scale of 1 to 10 (versus an industry average of 7.1) and garnered high ratings for technological leadership, after-sale support and software support. Shinkawa ranked eighth, with an uptime rating of 8.5.

ESEC, Shinkawa battle for top spot

(Die bonder sales, $ millions)

	1987	1988	1989
Shinkawa	11.5	15.5	19.0
ESEC	14.6	18.5	15.7
Kulicke & Soffa	3.4	5.9	6.8
General Signal	5.6	2.8	4.1
Kaijyo Denki	2.8	3.0	4.1
Toshiba	3.2	3.8	4.1

Source: VLSI Research Inc.

ESEC uses its field data to track whether design is the root of the problem; if so, the design is changed

To be sure, ESEC's location in Switzerland makes a quality program easier to implement. Unlike the United States, where companies often must teach their employees basic language and math skills, the country's educational system produces a supply of blue-collar workers with four years of technical training. ESEC can safely assume that these workers, who are responsible for assembling and customizing the bonders from modules manufactured by subcontractors, are skilled in such basic technical tasks as using computers or calculating statistical process control. While such workers demand high wages, says Lipton, "they're worth it."

Manufacturing quality at ESEC is monitored carefully. A typical bonder consists of 20 to 40 modules, designed by ESEC but manufactured by Swiss subcontractors who have long-standing relationships with ESEC. The subcontractors follow strict quality guidelines on production and undergo annual audits. If even a slight problem develops, the audit is conducted more frequently. "Every module either works or it doesn't," Lipton says. ESEC dropped four subcontractors last year because of reliability problems.

Some of ESEC's quality measures were introduced just for the production of the wire bonder, such as task forces on quality and on machine speed. The wire bonders also are ESEC's first product to feature two built-in, real-time process controls that immediately sense if the bonding force is correct.

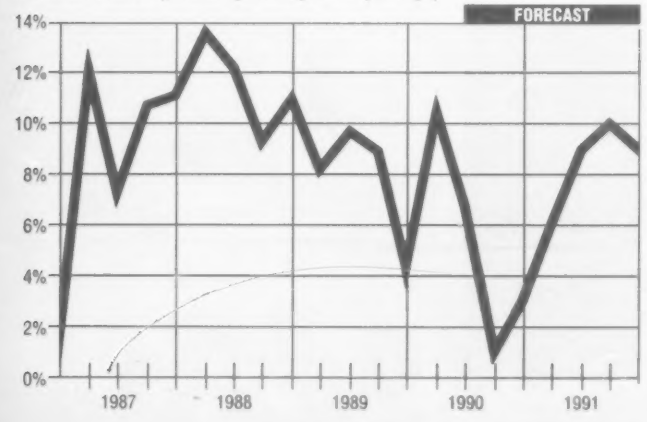
ESEC just started shipping its new die bonders, so customer response to the machines' quality will not come until later this year. But the real test of competitive quality will be customer support.

While ESEC faces serious marketing challenges, it seems well grounded in the basic precepts of quality. Two years ago, recalls Lipton, ESEC called in a Swiss quality consultant to make sure the company was on the right track. "He made some minor changes, but he couldn't make any proposals," says Lipton. "He just left." □

ELECTRONIC BUSINESS indexes

Profits index (percentage change from year ago)

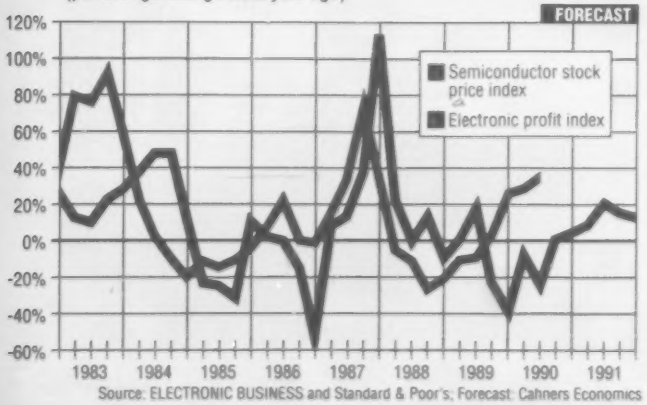
Revenue index (percentage change from year ago)



Source: ELECTRONIC BUSINESS; Forecast: Cahners Economics

Chip stock prices lead industry profits

(percentage change from year ago)



Source: ELECTRONIC BUSINESS and Standard & Poor's; Forecast: Cahners Economics

Here's why profits can rebound in 1991

The electronics industry profits languished in the second quarter of 1990 along with profit levels of the rest of U.S. industry. In fact, second-quarter electronics profits picked up only 3.8% from first-quarter levels, which were so weak that this small second-quarter gain kept profits a full 25% below what they were this time last year. For the four quarters ending June 1990, electronics industry profits had their steepest decline since 1986. Meanwhile, the electronics industry revenue growth continued upward on its slow growth path. Revenues in the second quarter rose 6.8% above levels a year ago.

According to the U.S. Commerce Department, all U.S. after-tax corporate profits fell 4.1% in the second quarter of 1990 from year-ago levels. The decline in corporate profits over the past year has also been the worst since 1986.

Yet profits in the electronics industry are expected to rebound, if not in 1990, then at least by 1991. How, in all this gloomy data, can ELECTRONIC BUSINESS economists predict a profit rebound?

For what it is worth, Wall Street agrees. As the bottom left chart shows, Standard & Poor's stock price index for semiconductor and component companies has been an extremely reliable indicator for electronics industry profits in the 1980s. Based on the most recent upturn in the stock price index, Wall Street is clearly betting on a return to profitability in the electronics industry.

Of course, any forecast for a quick run-up in profits next year depends mostly on one assumption: The U.S. economy will not experience a general recession. Even with uncertainty due to the Iraq situation, Cahners's economists believe the electronics industry and the economy can scrape by the rest of the year without a recession. Points may be shaved off the expected growth rates, but the fundamentals for a recovery remain.

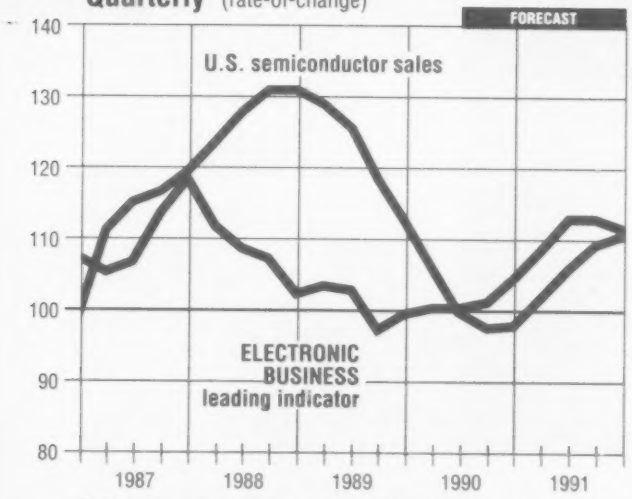
Shipments of electronic products will grow next year because inventories remain incredibly low. Interest rates will come down a bit, which will prop up economic growth. Business investment in information-processing equipment remains unhindered. An oil supply shock in 1990 is not at all like the shocks of the 1970s and cannot be expected to have the same impact on the economy.

As a result, the ELECTRONIC BUSINESS forecast for profit growth optimistically remains 14% in 1991, after a 9% decline this year.

ELIZABETH B. BAATZ

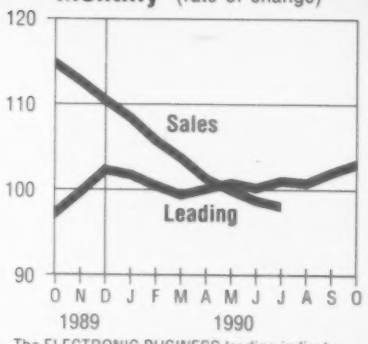
ELECTRONIC BUSINESS leading indicator

Quarterly (rate-of-change)



To obtain your complimentary copy of a 12-page background paper on the ELECTRONIC BUSINESS leading indicator, please contact Linda Spiller at Cahners Publishing Company, 275 Washington St., Newton, MA 02158-1630, USA, telephone (617) 630-2119, fax (617) 630-2100.

Monthly (rate-of-change)



The ELECTRONIC BUSINESS leading indicator continues to see modest gains. By July, the indicator remained at 101, essentially unchanged from year-end 1989 levels. In light of greater uncertainty due to the Persian Gulf situation, the indicator is expected to end 1990 at 106, instead of its previously-forecast 112.5. The timing of the next turning point peak remains in June of 1991, but with the magnitude revised down slightly to 114 from 116 as a result of the Middle East situation.

Source: Cahners Economics

Electronics industry indicators this month

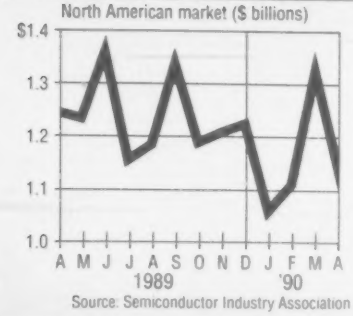
	Latest month	Previous month	Year ago	1989 average
ELECTRONIC BUSINESS leading indicator (rate-of-change, July)	101.0	100.7	99.0	100.9
U.S semiconductor bookings ($ millions, 3-month average, July)	$1,189	$1,270	$1,148	$1,205
Weekly hours of semiconductor production workers (monthly average, June)	40.5	40.7	40.0	40.1
Electronic component leadtime index (1977=100, August)	85.9	82.7	90.7	102.5
S&P's semiconductor stock price index (1970=10, monthly average, July)	78.2	79.7	55.4	54.7
Change in electronic components inventories ($ millions, SA, June)	-$18	+$62	-$184	-$12.8
Contracts and orders for plant and equipment ($ billions, SA, June)	$39.9	$40.6	$44.1	$43.4

SA = seasonally adjusted, all other data are not seasonally adjusted

Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Commerce Department, U.S. Bureau of Economic Analysis

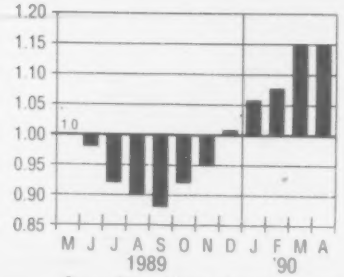
Semiconductor sales

North American market ($ billions)



Source: Semiconductor Industry Association

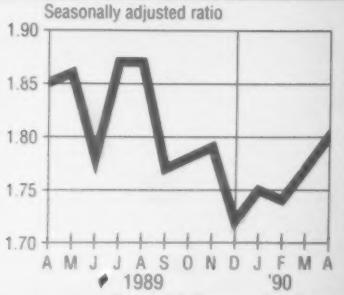
Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments

Seasonally adjusted ratio



Source: U.S. Commerce Department